

Investigating the Speed of Earthquake Waves

Key Concept

Earthquakes produce primary and secondary waves, which travel at different speeds. The time between the arrival of each wave type can be used to locate the earthquake epicenter.

Skills Focus

inferring, predicting, graphing

Time

40 minutes

Materials

pen or pencil

Advance Preparation

Have yarn, toys, and stopwatches available for More to Explore.

Teaching Tips

- Encourage students to use the Internet to learn more about earthquakes. A site at which students can track and predict earthquakes around the world is <http://athena.wednet.edu/curric/land/todayqk.html>
- Students may have trouble graphing seconds. Using a transparency of the grid or a grid on the chalkboard, have students locate several points to emphasize that each division is equal to 20 s.

Earthquakes ▪ *Laboratory Investigation***Investigating the Speed of Earthquake Waves****Pre-Lab Discussion**

An earthquake produces waves that travel away from the earthquake's epicenter, like ripples on a pond when you throw in a pebble. An earthquake produces three types of waves, primary (P waves), secondary (S waves), and surface waves. Seismologists track how far and how fast P and S waves travel to find the epicenter of the quake.

In this investigation, you will construct a travel-time graph for P and S waves. You will use the graph to answer some questions about earthquakes.

1. What causes an earthquake?

2. What is the epicenter of an earthquake?

Problem

How can you use a graph of earthquake waves' travel distance and time to find an epicenter?

Materials (*per group*)

pen or pencil

Procedure

1. An earthquake produced P and S waves that were recorded by instruments at 20 stations. These waves are listed in the Data Table on the next page. The table shows the distance traveled and the travel time for each wave. Using these data, construct a graph showing the relationship between the distance traveled by P and S waves and their travel times. Label the curves *P wave* or *S wave*.
2. Use your graph to answer the questions.

Name _____ Date _____ Class _____

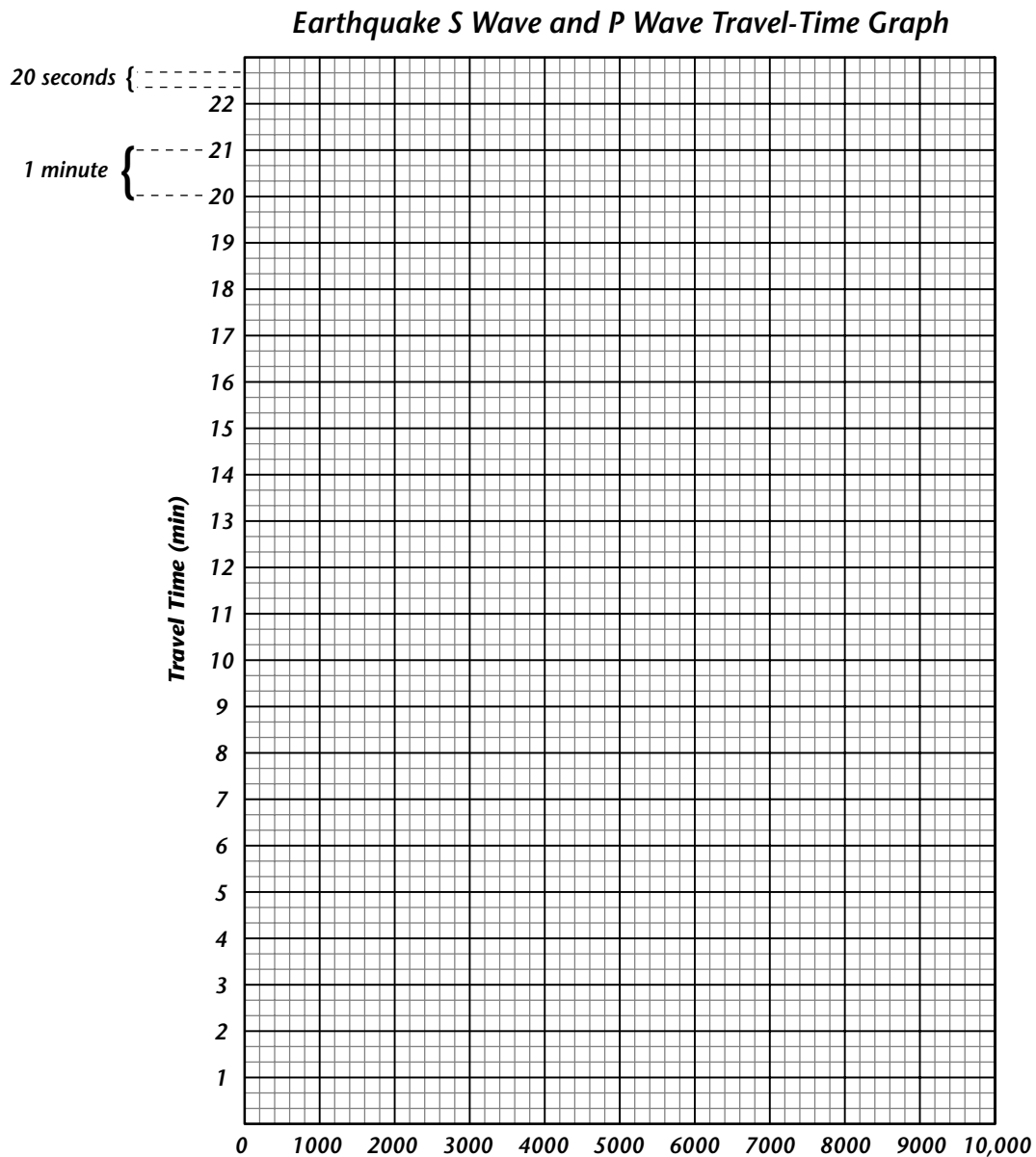
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Wave Type	Distance Traveled from Epicenter (km)	Travel Time	
		(min)	(s)
P	1600	3	20
P	6500	9	50
P	5400	8	40
P	2000	4	00
P	9600	12	40
P	700	1	30
P	7000	10	20
P	3400	6	10
P	8800	12	00
P	4000	7	00
S	2200	8	00
S	4000	12	40
S	5200	15	20
S	1700	6	30
S	6000	17	00
S	1100	4	20
S	7400	19	40
S	8200	21	00
S	500	2	10
S	9000	22	10

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Investigating the Speed of Earthquake Waves *(continued)*

Observations



Analyze and Conclude

1. If an earthquake occurred near you, would P waves or S waves reach you first? Explain your answer.

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- How long would it take a P wave to travel 8000 km from an earthquake epicenter? How long would it take an S wave to travel the same distance?

- Approximately how far is an observer from an earthquake epicenter if he or she observed a P wave 8 min after the earthquake?

- How could you tell which of two observers was farther from an earthquake epicenter by comparing the arrival times of P and S waves for the two locations?

Critical Thinking and Applications

- How far from an earthquake epicenter is an observer who measured a difference of 8 min 40 s in the arrival times of P and S waves?

- If a curve for surface waves were added to the graph, where would it appear? Explain.

- States along the West Coast, such as California and Washington, have much earthquake and volcanic activity. What does this activity indicate about the underlying rock structure of this part of the country?

More to Explore

Tie a piece of colorful yarn to a coil near the middle of a spring toy. Move the spring to create a P wave. Then move the spring to create an S wave. Which wave travels faster? Which kind of wave produces the most overall motion of the yarn? Which wave would cause more damage as a seismic wave?
